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Certificate

PATENT OFFICE
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DEPARTMENT OF TRADE
AND INDUSTRY

Hiermee word gesertifiseer dat
This is to certify that

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REC'D 06 JUN 2003

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the documents annexed hereto are true copies of:

Application forms P.1 and P.2, provisional specification and drawings
of South African Patent Application No. 2002/0579 as originally
filed in the Republic of South Africa on 23 January 2002 in the name
of Tsitsikamma Trust for an invention entitled: "ANALYSER
ARRANGEMENT".

**PRIORITY
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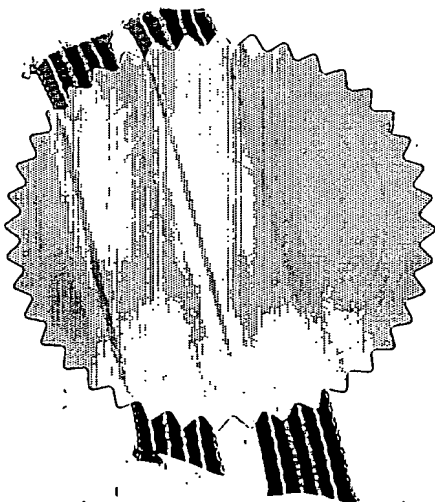
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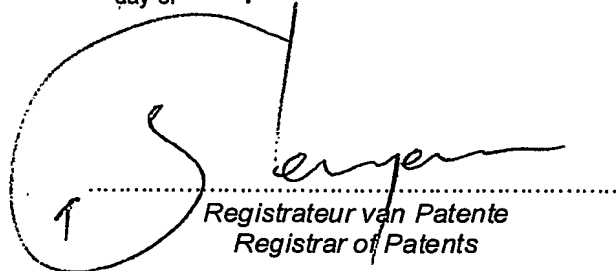
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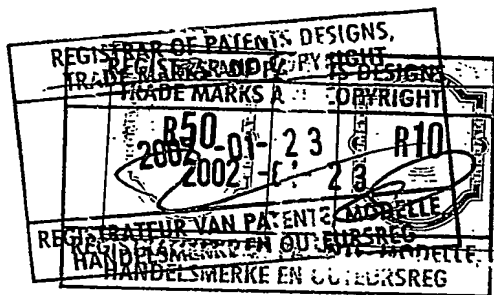
REPUBLIC OF SOUTH AFRICA				REGISTER OF PATENTS			
Official Application No.:				Lodging date: Provisional		Acceptance date:	
21	01	2002/0579		22	2002-01-23		47
International Classification:				Lodging date: Complete		Grant date:	
51				22			
Full name(s) of applicant(s)/Patentee(s):							
71	Tsitsikamma Trust						
Applicants substituted						Date registered	
71							
Assignee(s):						Date registered	
71							
Full name(s) of inventor(s)							
72	Francois Eberhardt DU PLESSIS						
Priority claimed		33	Country	31	Number	32	Date
Title of invention							
54	ANALYSER ARRANGEMENT						
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74	Patent of addition No.					Date of any change	
Fresh application based on					Date of any change		

PATENT APPLICATION AND ACKNOWLEDGEMENT

[Section 30(1) - Regulation 22]

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate.

21	01	Official Application No.: 2002/0579	DrG Ref.: 599014
71	Full name(s) and address(es) of applicant(s): Tsitsikamma Trust Rokewood Avenue Die Boord Stellenbosch 7600		
54	Title of invention: ANALYSER ARRANGEMENT		
The applicant claims priority as set out on the accompanying form P2. The earliest priority claimed is:			
This application is for a patent of addition to Patent Application No.			21 01
This application is a fresh application (section 37) based on Application No.			21 01



THIS APPLICATION IS ACCOMPANIED BY THE FOLLOWING:

- | | | | | |
|-------------------------------------|-----|----|--|-----------------|
| <input checked="" type="checkbox"/> | 1. | P6 | Provisional specification | Pages: 9 |
| <input type="checkbox"/> | | P7 | Complete specification | Pages: 2 copies |
| <input checked="" type="checkbox"/> | 2. | | Drawings | Sheets: 2 |
| <input type="checkbox"/> | 3. | P8 | Publication particulars and abstract in duplicate. | |
| <input type="checkbox"/> | 4. | | Drawing for abstract | |
| <input checked="" type="checkbox"/> | 5. | | An assignment of invention | |
| <input type="checkbox"/> | 6. | | Certified priority document(s) | |
| <input type="checkbox"/> | 7. | | Copy of Form P2 and SA Patent Application No | |
| <input type="checkbox"/> | 8. | | Translation of the priority document(s) | |
| <input type="checkbox"/> | 9. | | An assignment of priority rights | |
| <input checked="" type="checkbox"/> | 10. | P3 | Declaration and power of attorney on form P3 | |
| <input type="checkbox"/> | 11. | P4 | Request for ante-dating on form P4 | |
| <input type="checkbox"/> | 12. | P4 | Request for classification on form P9 | |
| <input checked="" type="checkbox"/> | 13. | P2 | Register sheet (in duplicate) | |

Date: 23 January 2002

DR GERNTHOLTZ
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74	ADDRESS FOR SERVICE: DR GERNTHOLTZ PATENT AND TRADE MARK ATTORNEYS P O BOX 8 CAPE TOWN 8000 SOUTH AFRICA 30 UNION ROAD MILNERTON 7441 TELEPHONE: +27 21 551 2650 TELEFAX: +27 21 551 2960	
REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT Official date stamp 2002 -01- 23 REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OuteursREG		

DECLARATION AND POWER OF ATTORNEY

[Section 30 - Regulations 8, 22(1)(C) and 33]

21	01	Patent/Application No.: 2002/0579	DrG Ref: 599014				
22		Lodging Date: 2002-01-23					
71	Full name(s) of applicant(s): Tsitsilamma Trust						
72	Full name(s) of inventor(s): Francois Eberhardt DU PLESSIS						
Earliest priority claimed		33	Country	31	Number	32	Date
		I					
54	Title of Invention: Analysar Arrangement						

I/We hereby declare that:

1. ☐ (Applicant(s) = Inventor(s))
I/We am/are the inventor(s) of the abovementioned invention and the applicant(s) mentioned above and have knowledge of the facts herein stated in my/our capacity as inventor(s) and applicant(s).
- ☒ (Applicant(s) = Assignee(s) of inventor(s))
The inventor(s) of the abovementioned invention is/are the person(s) named above; and the applicant(s) has/have acquired the right to apply by virtue of an assignment from the inventor(s).
I/We have been authorised by the applicant(s) to make this declaration and have knowledge of the facts herein stated in my/our capacity as indicated below.
2. ☒ To the best of my/our knowledge and belief, if a patent is granted on the application, there will be no lawful ground for the revocation of the patent.
3. ☐ This is a convention application and the earliest application from which priority is claimed as set out above is the first application in a convention country in respect of the invention claimed in any of the claims.
4. ☒ The partners and the qualified staff of the firm of DR GERNTHOLTZ, Patent Attorneys, Cape Town are authorised, jointly and severally, with powers of substitution and revocation, to represent the applicant(s) in this application and to be the address for service of the applicant(s) while the application is pending and after a patent has been granted on the application.

Signature: 1. *F. du Plessis* 2. 3.Name: F. du Plessis

Please print name of signatory in block letters.

Capacity:
Please indicate capacity (e.g. president, director, secretary) of signatory if signing on behalf of a company or corporation or any other legal body.Date: 23 Jan 2002Place: Cape Town

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REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978
PROVISIONAL SPECIFICATION

[Section 30(1) - Regulation 27]

21	01	Official Application No.: 2002/0579	DrG Ref: 599014
22	Lodging date: 2002-01-23		
71	Full name(s) of applicant(s): Tsitsikamma Trust		
72	Full name(s) of inventor(s) Francois Eberhardt DU PLESSIS		
54	Title of invention ANALYSER ARRANGEMENT		

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DrG REF 599014spec

TITLE OF INVENTION

Analyser arrangement.

FIELD OF INVENTION

5 The present invention relates to analyser arrangements.

More particularly, the present invention relates to analyser arrangements for online spectral analysis of mineral slurry flows.

BACKGROUND TO INVENTION

10 In order to control mineral processing plants, determination of mineralogical composition of various slurry flows in the plant is required. Known methods include laboratory chemical analysis. However, in some cases automation of this process does not produce reliable results and only manual methods prove to be reliable. Furthermore, the determination of elemental chemical composition alone (XRF - X-ray
15 fluorescence spectrography) does not provide all the necessary information. Furthermore, due to the variability in chemical composition it is not possible to utilise this method for the exact description of mineralogical composition. Accordingly, automation of the mineral analysis procedure is required.

20 It is an object of the invention to disclose an analyser arrangement for online spectral analysis of mineral slurry flows.

SUMMARY OF INVENTION

According to the invention, an analyser arrangement for determining the composition of a mineral slurry flow, includes online spectral analysis means for determining the composition of a mineral slurry flow.

5 Also, according to the invention, a method of determining the composition of a mineral slurry flow, includes the steps of

- (a) illuminating a mineral slurry flow to cause light reflection therefrom;
- (b) sensing the light reflected by the mineral slurry flow; and
- 10 (c) analysing the light reflected by the mineral slurry flow by spectral analysis to determine the composition of the mineral slurry flow.

The online spectral analysis means may include

- 15 (a) illumination means for illuminating the mineral slurry flow to cause light reflection therefrom;
- (b) sensing means for sensing the light reflected by the mineral slurry flow;
- (c) a spectrometer for analysing information supplied by the sensing means, and thereby determining the spectral
- 20 distribution of the reflected light; and
- (d) a data processor for evaluating information supplied by the spectrometer and thereby determining the composition of the mineral slurry flow.

The illumination means and sensing means may be associated with a probe.

A protective housing may be provided to shield the probe from the mineral slurry flow.

- 5 The protective housing may include a transparent tip.

The transparent tip may be made of sapphire.

The transparent tip may be inclined towards the flow of the slurry to cause cleaning of the tip.

The probe may include optical fibres.

- 10 The illumination means may include illuminating fibres.

The sensing means may include sensing fibres.

The illumination means may emit UV (ultra-violet) and/or visible and/or IR (infra-red) light.

- 15 The processor may identify the spectral identities of minerals in the mineral slurry flow.

The processor may calculate the quantity of each mineral in the mineral slurry flow.

The analyser arrangement may provide real-time information of the mineral composition.

- 20 The analyser arrangement may be provided with operation means for automatic control of a mineral processing plant.

The analyser arrangement may be calibrated by means of a bench-top mineral analyser.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described by way of example with reference to the accompanying schematic drawings.

In the drawings there is shown in:

Figure 1: a perspective view of an analyser arrangement in accordance with the invention;

Figure 2: a sectional side view of the analyser arrangement seen along arrows II-II in Figure 1;

Figure 3: a sectional top view of the analyser arrangement seen along arrows III-III in Figure 2; and

Figure 4: a sectional side view of the analyser arrangement seen along arrows IV-IV in Figure 3.

DETAILED DESCRIPTION OF DRAWINGS

Referring to Figures 1 to 4, an analyser arrangement for online analysis of a mineral slurry flow in order to determine the composition of the mineral slurry flow, generally indicated by reference numeral 10, is shown.

The analyser arrangement 10, in use located in proximity of mineral conveying means 12, such as a pipe or conduit, and conveying a mineral slurry flow 14 to be analysed, includes a probe 16 positioned within the moving mineral slurry flow 14.

The probe 16 is provided with two types of optical fibres (not shown), illuminating fibres and sensing fibres. Light emitted by the illuminating fibres is selectively reflected by the minerals in the mineral slurry flow 14, and the reflected light is picked up by the sensing fibres, whereafter information is sent via the probe output 18 to a spectrometer (not shown) which senses the spectral distribution of the light reflected by the minerals in the mineral slurry flow 14, and transmits the digital output to a data processor (not shown). The data processor output includes seven 4-20 mA signals, each corresponding to a percentage of mineral occurrence.

- 10 The light emitted by the illuminating fibres include visible and NIR (near infra-red) reflected from the slurry flow according to the mineral composition and impurities therein. Accordingly, the spectrometer is classified as a visible and NIR spectrometer.

- 15 The processor thereafter identifies the digital output or spectral "fingerprints" of the different minerals in the mineral slurry flow 14, and calculates the abundance of each mineral of concern in the mineral mineral 14. The processor output may include an operator user-friendly interface.

- 20 Also, the analyser arrangement 10 is provided with a protective housing 20 to shield the probe 16 from the mineral slurry flow 14. The protective housing 20 is provided with a transparent tip 22, angled at 45° towards the oncoming slurry. The transparent tip 22 is made of sapphire.

- 25 Calibration of the analyser arrangement may be achieved by means of a bench-top analyser model where changes in the mineralogy of the mineral slurry flow 14 occurs.

The implementation of the analyser arrangement is achieved in various phases, namely:

- (a) Amenability study;
- (b) Desktop analyser arrangement; and
- 5 (c) ON-line analyser arrangement.

During the amenability study phase, a representative set of mineral samples is obtained by the user. The number of known samples required at this stage is $n=(m+1)^2$, where n is the number of samples, and m is the number of mineral mixtures to be differentiated. The accuracy of the
10 composition of these samples determines the final accuracy of the analyser arrangement according to the invention. An analysis and training set for the specific set of minerals is performed, and an expected level of accuracy is calculated.

During the desktop analyser arrangement phase, a desktop analyser, set up
15 according to the results of the amenability study, is constructed and includes:

- An industrial computer preloaded with analysis and data storage software,
- A spectrometer,
- 20 - A light source, and
- A probe assembly.

Initially, the system is provided with rough calibration and tuning, however final tuning has to be performed over a time span, for example four to eight weeks, in order to achieve full accuracy.

The spectral data of several samples and the known values for these samples are determined and thereafter utilised for obtaining final tuning parameters, to be loaded in the bench top model.

Finally, during the on-line analyser arrangement phase, the on-line analyser arrangement in accordance with the invention is constructed.

Accordingly, the analyser arrangement 10 in accordance with the invention provides an arrangement and method to achieve accurate and frequent measurements of mineral slurry flows in mineral processing operations. The on-line analyser arrangement provides mineral concentrator operations with real-time information of the mineral composition of mineral slurry flows and provides the option of automatic control.

Date: 23 January 2002


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599014spec

LIST OF REFERENCE NUMERALS

- 10 Analyser arrangement
- 12 Mineral conveying means
- 14 Mineral slurry flow
- 16 Probe
- 18 Probe output
- 20 Protective housing
- 22 Transparent tip

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TSITSIKAMMA TRUST

NO OF SHEETS 2
SHEET NO 2
DRG Ref.: 599014

FIG. 3

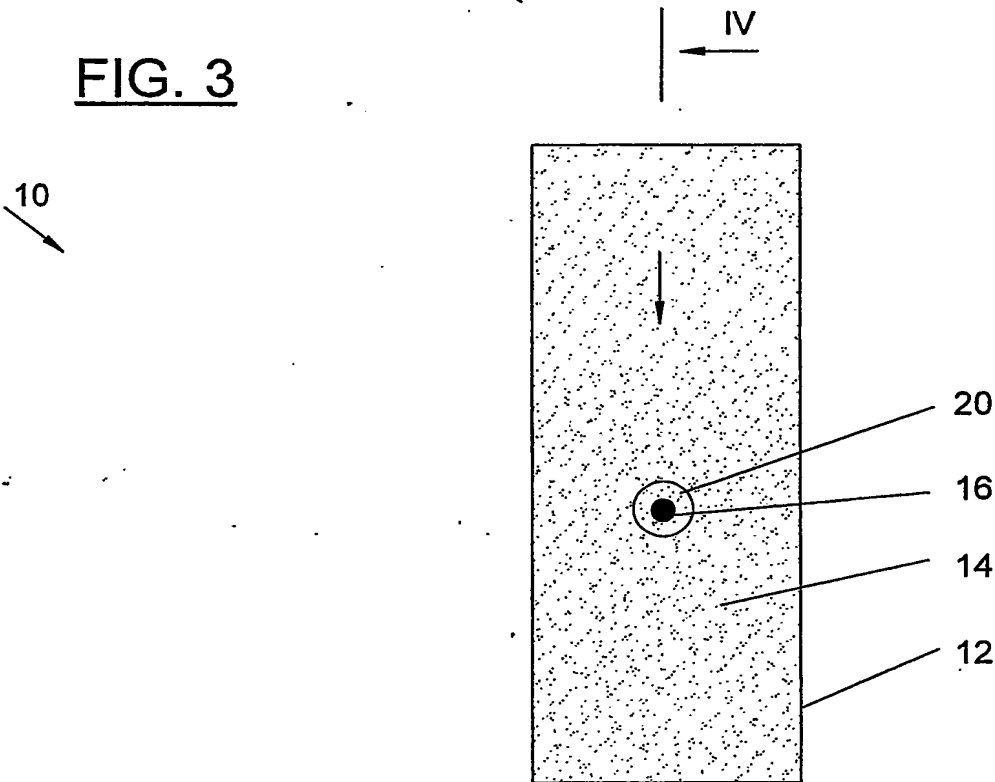


FIG. 4

